Comparison of global RHESSI and AGILE TGFs distributions and analysis of all AGILE satellite passes over South America. 2009-2012 period.

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RHESSI and AGILE TGFs distributions in the period 2009-2012 are compared. Analysis of differences in geographical, hourly, monthly distributions of the three main TGF production regions in Earth due to differences in lightning production and ITCZ movement is presented. A fourth region producing TGFs over Pacific not reported before is also analysed. Second analysis has been performed in order to identify preferable meteorological conditions for TGF production. Some publications suggested that regional differences in lightning/TGF ratio may be due to differences in meteorological thunderstorm and lightning production. All AGILE passes over South America (SA) in 2009-2012 has been studied. No special meteorological features characteristic of SA has been identified. TGFs are detected in situations with many lightning, thunderstorms, high CAPEs and high Top Clouds. TGFs are more probable to be detected in active situations.

1. Introduction

Since their discovery TGFs have been related with thunderstorm and lightning, firstly because they are mainly produced over land-ocean and land regions on tropic were lightning production is the highest, the so-called three lightning chimneys[1], and secondly because direct link between individual lightning and TGFs has been established. Analysis between lightning and TGF diurnal cycles and Inter Tropical Convergence Zone (ITCZ) and TGF production seasonal migrations reinforce this correlation [2].

Williams suggested in 2006 [3] that TGF were more observed on tropics because they were produced by Intra Cloud lightning more high in the troposphere, were atmospheric absorption is lower making to escape and reach satellites. However, other publications that reports thunderstorms producing TGFs of 13-14km [2] and less TGF production than expected in some regions compared to others [4,5], suggested that other meteorological variables may play an important role on TGF production than only tropopause altitude.

In order to analyse this differences and try to find out preferences for TGF production we present first a comparative of RHESSI[6] and AGILE TGFs and WWLLN lighting monthly, diurnal and geographical differences in the 2009-2012 period. Secondly, different meteorological variables during all AGILE[7,8] passes detecting and non-detecting a TGF in 2009-2012 period has been analysed. On this report only part of the results are presented (Complete results, data acquisition and methodology will be presented at 2nd TEA – IS Summer School)

2. Results

2.1. Global TGF distributions

Longitudinal distribution of RHESSI and AGILE TGFs for 2009-2012 period is plotted in figure 1. A significant forth TGF production region has been identified over the Pacific, oceanic region unlike the other 3, although not so active as the other three previously reported. Although AGILE inclination is quite lower, total number of TGFs detected are similar, 351 RHESSI and 308 AGILE, showing that TGFs are more frequent or easier to detect on tropics.

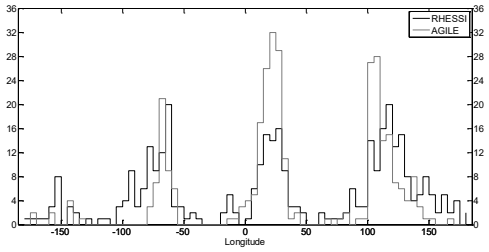

Figure 1. Longitudinal distribution of AGILE and RHESSI TGFs. 2009-2012.

On figure 2 is plotted the diurnal cycle for the same TGFs for each TGF production region shown in figure 1. Maximum and minimum reported by Splitt (2010) at 17 LST and 12 LST can be

identified. Other maximum is identified in all regions around 5 LST, although its magnitude varies depending on the region

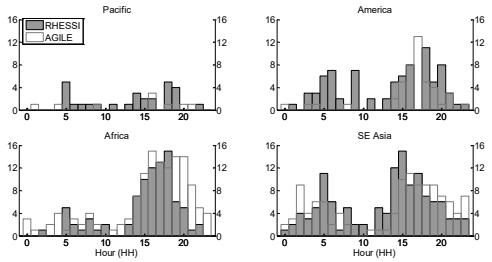

Figure 2 Diurnal Cycle of AGILE and RESSI TGF for the 4 regions with more TGF production. 2009-2012.

2.2. AGILE passes over South America

The objective of this second part is to compare real situations conducing and non-conducing to TGFs. All AGILE passes over SA in 2009-2012 period have been divided in 3 squares, covering satellite field of view, to be studied.

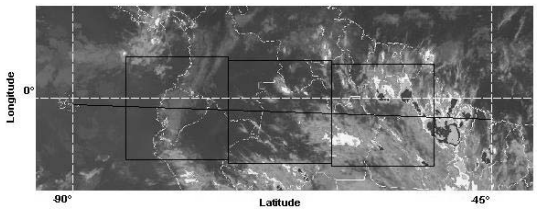

Figure 3 Random AGILE pass over South America. The 3 squares of 1200 km side (AGILE field of view) are the three regions analysed for each case. Left square is considered land-ocean region and the other 2 land region.

Number of strokes, storms, Top Cloud coverage, Top Cloud temperature and CAPE for each square have been analysed. Figure 3 shows 3 squares analysed for a random pass. For each variable, 4 different ranges have been analysed plotting monthly and diurnal distributions for 4 situations: land-ocean TGF, land-ocean no TGF, land TGF and land no TGF. Figure 4 shows the diurnal cycle for CAPE only on 2011, with 7 TGFs. It is clear on this graphic that TGFs are produced in situations with high CAPE, although these kind of situations suppose only 20-30% of the total. This high CAPE situations also follows same diurnal cycle seen in section 2.1, with high peak around 15LST. Situation with low CAPE are more probable at first hours of the day.

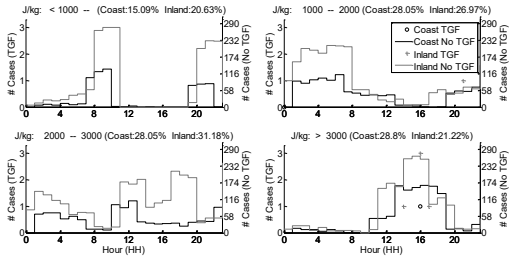

Figure 4. Diurnal Cycle of 4 ranges of CAPE of all Passes over SA on 2011 of cases over lamd-ocean region with and without TGF and over land with and without TGF.

3. Conclusions

Diurnal Cycle is different for each region, especially for the peak at first hours of the day. That agrees with previous studies suggesting that regional meteorological differences may differentiate TGF production.

For passes study, we show on this report that TGFs tend to occur at situations with high CAPE (only 7 TGFs on 2011 over SA). Although AGILE covers many situations with low CAPE and lightning and thunderstorms occurring, no TGFs are detected

More conclusions will be presented at 2nd TEA – IS Summer School; point 2.2 extended to 2009, 2010 and 2012 what will permit to obtain more conclusive results because of the increase of TGF cases.

4. References

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